

WHAT IS CLAIMED IS:

1 1. A system for removing an obstruction from a blood vessel, comprising:
2 a catheter having a lumen;
3 an expandable capture element which is contained within the lumen of the
4 catheter, the capture element being slidable within the lumen of the catheter between a
5 collapsed position contained within the lumen and an expanded position in which the capture
6 element is positioned outside the lumen; and
7 an obstruction engaging device having a filament, the filament being movable
8 from a collapsed position to an expanded position, the obstruction engaging element passing
9 through the catheter.

1 2. The system of claim 1, wherein:
2 the expandable capture element is naturally biased toward the expanded
3 position when positioned outside the lumen.

1 3. The system of claim 3, wherein:
2 the expandable capture element has a support structure with a flexible cover
3 attached to the support structure.

1 4. The system of claim 3, wherein:
2 the self-expanding support structure has a closed loop having integrally formed
3 hinges.

1 5. The system of claim 4, wherein:
2 the hinges are V-shaped interconnecting elements.

1 6. The system of claim 3, wherein:
2 the support structure has a plurality of longitudinal struts extending from the
3 loop.

1 7. The system of claim 1, wherein:
2 the capture element has an expandable loop at the distal end.

1 8. The system of claim 7, wherein:

2 the loop is formed by an eyelet with a control arm extending through the
3 eyelet.

1 9. The system of claim 1, wherein:
2 the capture element has a flexible cover, the cover having a length which is at
3 least three times an expanded diameter of the capture element.

1 10. The system of claim 9, wherein:
2 the length of the cover is at least five times the expanded diameter of the
3 capture element.

1 11. The system of claim 1, wherein:
2 the engaging device has 1-4 filaments.

1 12. A method of removing an obstruction from a blood vessel comprising
2 the steps of:
3 providing a catheter, an obstruction engaging device and an expandable
4 capture element, the capture element being contained within a lumen of the catheter in a
5 collapsed position, the capture element moving to an expanded position when positioned
6 outside the lumen, the obstruction engaging device having a filament which is movable from
7 a collapsed position to an expanded position;
8 introducing the catheter into a blood vessel of a patient;
9 engaging an obstruction with the filament;
10 expanding the capture element; and
11 moving the obstruction into the capture element with the engaging device after
12 the engaging and expanding steps.

1 13. The method of claim 12, wherein:
2 engaging step is carried out with the filament penetrating and ensnaring the
3 obstruction.

1 14. The method of claim 12, wherein:
2 the expanding step is carried out with the capture element being naturally
3 biased toward the expanded position with a self-expanding support structure.

1 15. The method of claim 14, wherein:
2 the providing step is carried out with a flexible material attached to the support
3 structure.

1 16. The method of claim 15, wherein:
2 the providing step is carried out with the self-expanding support structure
3 having a closed loop.

1 17. The method of claim 15, wherein:
2 the providing step is carried out with the loop being integrally formed.

1 18. The method of claim 15, wherein:
2 the providing step is carried out with the support structure has a plurality of
3 longitudinal struts.

1 19. The method of claim 18, wherein:
2 the providing step is carried out with the loop being formed by a number of
3 integrally formed hinges.

1 20. The method of claim 19, wherein:
2 the providing step is carried out with the hinges being V-shaped elements.

1 21. The method of claim 12, wherein:
2 the obstruction engaging element has 1-4 filaments.

1 22. A system for removing an obstruction from a blood vessel, comprising:
2 a catheter having a lumen;
3 an expandable capture element contained within the lumen of the catheter, the
4 capture element being in a collapsed position when contained within the lumen and being in
5 an expanded position when positioned outside the lumen, the expandable capture element
6 having a support structure forming a closed loop having a plurality of integrally formed
7 hinges; and
8 an obstruction engaging device which extends through the expandable capture
9 element, the engaging device having a collapsed shape and an expanded shape.

1 23. The system of claim 22, wherein:
2 the capture element has a flexible cover attached to the support structure, the
3 cover having a distal end which is positioned at the loop so that the loop opens the distal end
4 of the cover.

1 24. The system of claim 22, wherein:
2 the support structure has a plurality of longitudinal struts which extend
3 proximally from the loop.

1 25. The system of claim 24, wherein:
2 the struts do not intersect and form a form a conical shape when the capture
3 element is in the expanded.

1 26. The system of claim 22, wherein:
2 the loop has integrally formed hinges.

1 27. The system of claim 26, wherein:
2 the hinges are formed by V-shaped elements.

1 28. The system of claim 22, wherein:
2 the obstruction engaging device has a filament configured to penetrate and
3 engage an obstruction.

1 29. A system for removing an obstruction from a blood vessel, comprising:
2 a catheter having a lumen:
3 an expandable capture element which is contained within the lumen of the
4 catheter, the capture element being slidable within the lumen of the catheter, the capture
5 element having an actuator for manually expanding and contracting the capture element; and
6 an obstruction engaging device which passes through the capture element.

1 30. The system of claim 29, wherein:
2 the obstruction engaging devices includes a filament for engaging the
3 obstruction.

1 31. The system of claim 29, wherein:

2 the actuator has a control arm and a stable arm. the control arm being
3 manipulated to expand and collapse the capture element.

1 32. The system of claim 29, wherein:
2 the actuator has a loop and a control arm which is manipulated to open and
3 close the loop.

1 33. The system of claim 29, wherein:
2 the capture element everts when moving outside the lumen.

1 34. The system of claim 29, wherein:
2 the actuator includes a tube and a wire extending through the tube.

1 35. The system of claim 29, wherein:
2 the actuator includes at least two wires.

1 36. The system of claim 35, wherein:
2 the actuator includes first and second stabilizing wires and at least one
3 actuating wire.

1 37. A catheter for capturing an obstruction, comprising:
2 a catheter having a lumen;
3 a capture element positioned in the lumen of the catheter, the capture element
4 being expandable, the capture element having an expandable support structure and a cover
5 attached to the support structure, the cover having a length which is at least three times a
6 diameter of the support structure in the expanded position.

1 38. The catheter of claim 37, wherein:
2 the cover has a length which is at least five times a diameter of the support
3 structure in the expanded position.

1 39. A device for removing an obstruction from a blood vessel, comprising:
2 an expandable loop which is movable from a collapsed position to an
3 expanded position;

4 a cover coupled to the loop, the distal end of the cover being moving from a
5 closed position to an open position when the loop moves from the collapsed to expanded
6 positions; and

7 a tube having an actuator extending therethrough, the actuator being coupled
8 to the loop so that relative movement between the tube and the actuator causes the loop to
9 move between the expanded and collapsed positions.

1 40. The device of claim 39, wherein:
2 the tube is positioned outside the cover.

1 41. The device of claim 39, further comprising:
2 a catheter passing through the cover; and
3 an obstruction engaging device passing through the catheter.

1 42. A device for removing an obstruction from a blood vessel, comprising:
2 a tube;
3 a support structure movable between a collapsed position and an expanded
4 position, the support structure extending through the tube and being naturally biased toward
5 the expanded position, wherein the support structure expands when moved out of the distal
6 end of the tube and is in the collapsed position when contained within the tube, the support
7 structure being bowed outward;
8 a cover coupled to the structure, the cover moving from a closed position to an
9 open position when the loop moves from the collapsed position to the expanded position.